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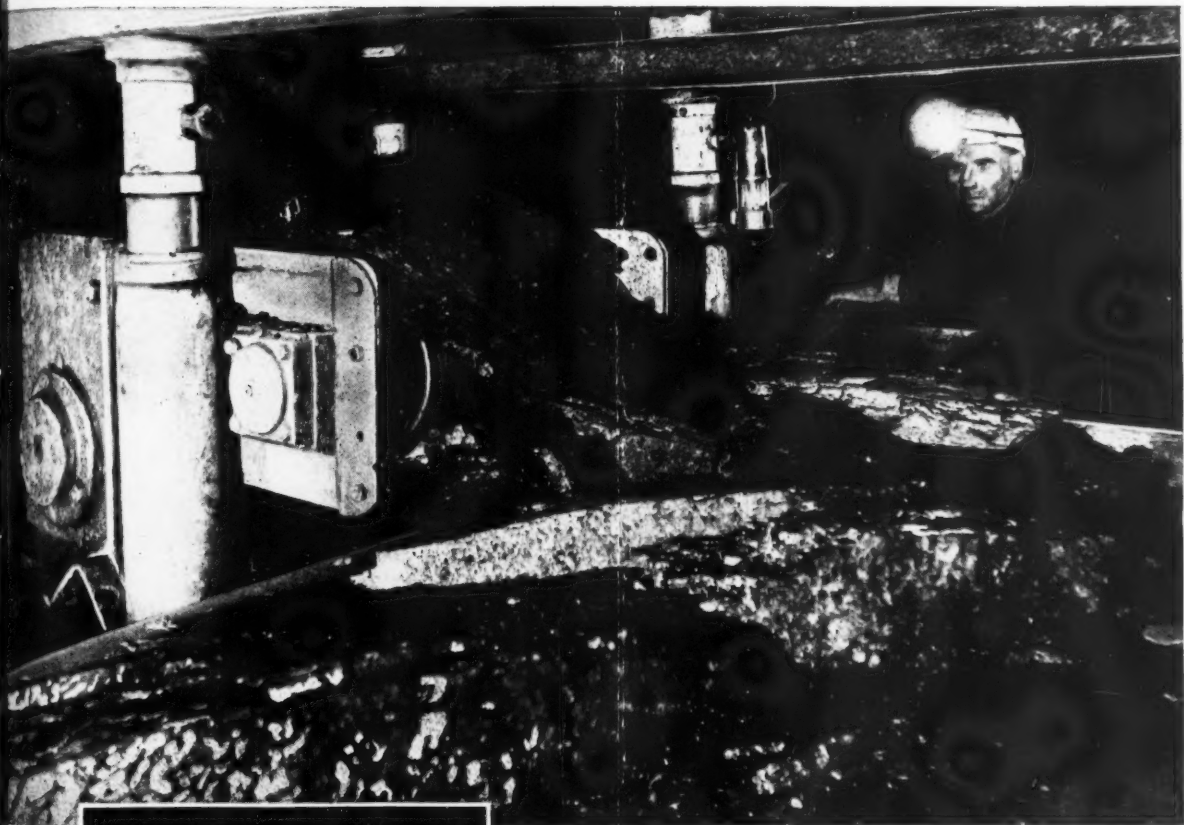
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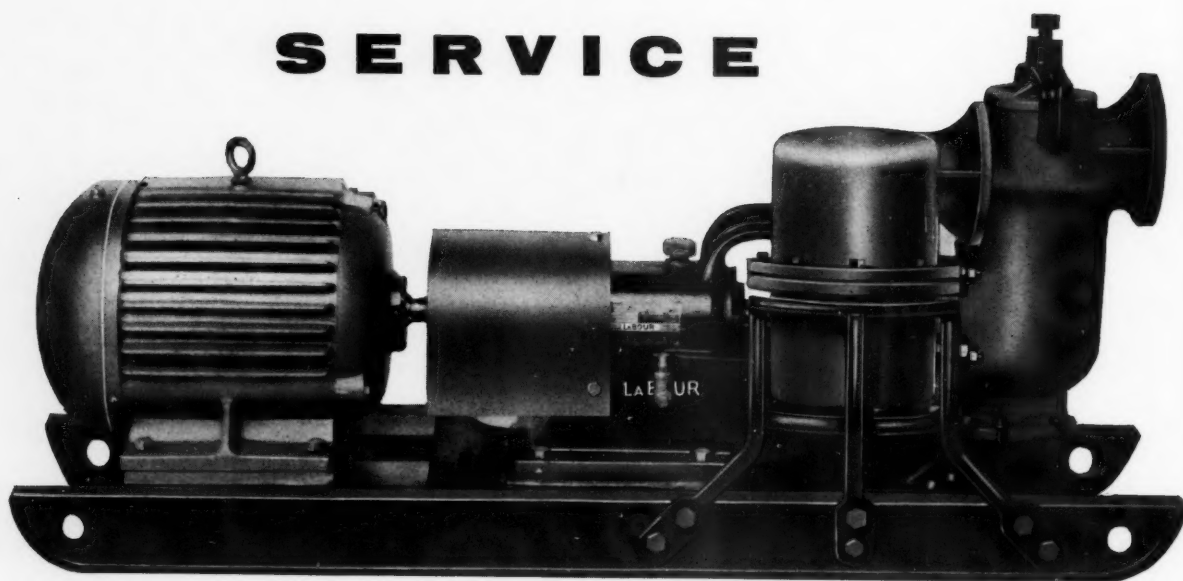
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The Mining Journal

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U. Baliol Scott

Deputy Editor

A. Graham Thomson

Assistant Editor

R. Bowran

Assistant Financial Editor

R. A. Nuttall

Display Advertisement Manager

E. S. Hooper

Circulation

Robert Budd

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E. Baliol Scott
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(Managing)

G. A. Baliol Scott

R. A. Ellefsen

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Research on Corrosion

CORROSION is estimated by the National Association of Corrosion Engineers to cost the U.S. some \$7,000,000,000 a year. Dr. J. C. Hudson calculated some years ago that the cost of protection of steel in the U.K. amounted annually to a figure in the region of £200,000,000. In the light of these staggering figures, it is scarcely surprising that on both sides of the Atlantic, the war on corrosion should occupy a high priority in the research programmes of both Government Laboratories and commercial firms. For the mining industry this work is of two-fold importance, in that not only does it lead to equipment capable of giving improved service and longer life in the highly corrosive conditions often encountered both on the surface and underground, but it also opens up new market opportunities for corrosion-resistant metals.

The nuclear era has, of course, given a further impetus to research on corrosion by the growing demand for materials capable of giving dependable performance under more and more exacting service conditions. Higher pressures, higher temperatures, and a variety of new physical and chemical requirements are being superimposed on the old familiar needs.

To quote from a recent survey of U.S. research on corrosion by the *Wall Street Journal*, "in hit-or-miss fashion, man has been fighting corrosion ever since he first rubbed a little grease on the blade of his hunting knife. But it has only been during and since World War II that the calculating methods of the scientist and engineer have been applied broadly to fight corrosion."

"Corrosion Research in Great Britain and its Results" was the subject of a paper presented by W. E. Ballard, managing director of Metallisation Ltd., before the Base Metals Division of the South African Institute of Mining and Metallurgy (*J. S.A.Inst. Min. & Met.*, vol. 59, No. 12, July 1959). All over the world, states Ballard, industrial organizations have their own laboratories dealing with specific corrosion problems and in Great Britain there exist also independent bodies so constituted that their findings are not likely to be coloured by commercial considerations. Committees sponsored by these bodies or by government departments have been set up and have access not only to their own results, but to most of the information being obtained by the more enlightened industrial undertakings.

Ballard defines corrosion as the return of metals by natural processes to the state in which they were before men extracted them from the earth. By the use of energy in metallurgical furnaces men reduce ore to metal, and by its slow loss nature returns the metal to the form of lowest energy.

The major achievements in corrosion science during the past two or three decades are listed as follows: (1) Realization of the part played in control of corrosion by thin surface films on metals, whether normally occurring or artificially produced; (2) realization that corrosion is in general an electrochemical phenomenon; and (3) realization that some types of corrosion are stimulated by living organisms.

Corrosion research, it is emphasized, is not a spectacular branch of science. Accelerated tests, sometimes useful as a guide, can be misleading. In the main, results from practical experiment must be the final consideration. Corrosion fortunately is a slow process and field tests extending over years may be necessary.

As examples of the independent organizations in the U.K. which have added to our knowledge of corrosion, Ballard draws attention to work at Cambridge University, under Dr. Ulick Evans and now being continued under Dr. J. E. Mayne by Dr. T. P. Hoar; the investigations of the British Iron and Steel Research Association, the Corrosion Section of which is controlled by Dr. J. C. Hudson; the work of the British Non-Ferrous Metals Research Association; and the investigations of the Corrosion Division at the National Chemical Laboratory, Teddington, for many years guided by Dr. W. H. J. Vernon and now controlled by Dr. Wormwell.

An impressive indication of the scope and nature of B.I.S.R.A.'s current work on corrosion appears in the annual report for 1958. The report refers, *inter alia*, to the start of a new series of tests on priming paints for sprayed zinc and sprayed aluminium coatings on two new sites, one being at Stratford in London, and the other on Pilsey Island near Chichester Harbour. Various long-term investigations on metal coatings and priming paints for bare steel when exposed to the open atmosphere are still in progress at Brixham, Derby and elsewhere. Coated cast-iron pipes that had been buried for five years at Benfleet, Brill and Pitsea were recently removed.

In 1951, as a result of discussions initiated by Vernon and the Honorary Officers of the Society of Chemical Industry, many of the workers in the corrosion field were invited to set up within the Society a Corrosion Group, the aim of which was to establish a platform on which corrosion and protection problems could be discussed. Under the present chairmanship of Dr. S. G. Clarke, with S. C. Britton as hon. secretary, the group now has a membership of well over 500. Although it does not carry out or sponsor research, it forms a convenient centre for discussion and holds a yearly exhibition at Battersea, as well as some eight or nine meetings a year. Sometimes symposia of an international character are held.

In the U.S. increased interest in the subject is indicated by the growth of the National Association of Corrosion Engineers, a group formed in 1943 with 11 members. Today, it has 6,300 members and its ranks are swelling at the rate of 10 per cent a year. Formed as recently as 1955, and sponsored by firms in the metal industries, another U.S. body, the Corrosion Research Council is also focusing attention on research problems in this field.

Recent advances in cathodic protection have resulted in spectacular successes, not only in the shipping industry—its largest and best-known field—but also in protecting buried pipelines from corrosion. Dow Chemical Co. reports that cathodic protection of underground structures and transmission facilities has resulted in a drastic reduction of plant maintenance costs.

Much effort is being devoted in both Britain and the U.S. to the development of new alloys better able to resist corrosion, or towards finding new uses for such rust-resisting materials as stainless steel and aluminium. The results of one of the most intensive corrosion testing programmes ever undertaken with titanium, zirconium and other alloys are now being released to U.S. industry by Columbia-Southern Chemical Corporation. More than 2,300 specimens of about 40 different corrosion-resistant metals and alloys were tested over a 15-month period in nearly 145 different corrosive environments. Organizations co-operating in the tests included Union Carbide, Haynes Stellite and Union Carbide Metals, Inco, Alcoa and the U.S. Bureau of Mines.

Alcoa reports that the rust-resisting characteristics of aluminium are playing an important role in extending the uses of this metal. A recently built ore carrier contains 136 tons of aluminium in its superstructure, eliminating the need for painting these surfaces. Aluminium coatings on steel are also finding new applications.

Although research has led to the development of new and highly efficient tools for the corrosion engineer, paint remains by far the most widely used method of protection. Maintenance engineers have estimated that 25 per cent of every dollar spent on plant maintenance goes on painting. Here, too, research continues to yield fruitful results, among the newer products of paint and chemical factories being silicone and urethane coatings.

JOHORE AND MALACCA SURVEY

The fourth part of the report on the Colombo Plan aerial magnetometer and scintillation counter survey of six areas of the Federation of Malaya has now been published, as Economic Bulletin 1.5, by the Federation's Geological Survey Headquarters.

The area covered by the latest issued report, described as "Area 5—West Johore and South Malacca", consists of a block of 1,592 square miles of the western coastal area immediately south of Malacca.

Mr. J. R. Paton, Principal Geologist, describes the topography of the area as being divisible into two parts—the flat alluvial plain, of variable width, along the coast; and the main rivers and the undulating hills which protrude irregularly from the plains. None of the hills is high, the highest point being Ma'Okil, 1904 feet. He states that little detailed work has been done in the area and current maps may require considerable revision.

There are essentially only two rock groups; a series of quartzites and shales in varying proportions is the most extensive. The rocks have been assigned to the "Younger Arenaceous Series", believed to be of Triassic age, although the presence of outcrops of volcanic rocks suggests that older rocks than the Permian occur.

Granite, believed to be late Cretaceous, occurs in a number of isolated areas, and a small patch of Tertiary rocks occurs north of the area near Kepong. There, coal seams occur in the Tertiary sediments but have never been worked.

The area generally is considered to be poor in minerals, although it contains what is probably an extension of the prolific tin ore bearing Main Range granite. Columbite occurs in lodes associated with a small granite mass near Bakri, east of Muar. Several mines have been worked within the last few years but the sudden fall in price caused interest to decline.

Some small iron ore deposits had been reported from time to time, mostly secondary limonite and goethite, but up to the time of the survey none had proved workable.

Mr. Paton says that the country is low, the rocks deeply weathered and information is difficult to obtain by ground survey. It was hoped that the aeromagnetic survey would reveal whether any of the small iron ore deposits were the secondary cappings of extensive underground bodies.

In his report, Dr. W. B. Agocs, Chief Geophysicist, details a number of magnetic and radioactive anomalies, very few of which are, however, considered by him to be of economic interest. In interpreting magnetic susceptibility contrasts Dr. Agocs takes the susceptibility contrast value of $3,300 \times 10^{-6}$ cgs units for the iron ore mass of the large iron ore mining area of Bukit Besi in Trengganu as a base for possible iron ore concentrations. On this basis he indicates one

location within Area 5, with a similar susceptibility contrast, which he considers may be of value.

Most of the radioactivity highs are considered to be probably due to igneous masses or variations in clay content of the soil and not to local concentrations of radioactive minerals of commercial interest. Dr. Agocs does, however, recommend ground investigation of one defined part of the area in which peak radioactivity values range up to 4 to 5 times above normal background count. He also defines another part of the area where there is a broad zone in which radioactivity is twice that of the background count and on which are superimposed both large and small zones in which the radioactivity is 3 times the normal background count.

"It is doubtful", says Dr. Agocs, "if these deviations are caused by commercial concentrations of radioactive material, but at least one or two of the indicated sites should be checked in order to determine the probable source of radioactivity, although they are at present interpreted as being due to uranium salts contained in clays".

Following the same presentation as the three previously published parts of the report, an appendix contains an interpretative summary by Dr. J. B. Alexander, the Director of Geological Survey, Federation of Malaya. He refers to the anomalous zone mentioned by Dr. Agocs as having susceptibility contrasts similar to those over Bukit Besi, and says that the most probable cause is basic intermediate igneous rock, possibly with ferri-ferrous ore concentrations. These anomalies are in the Bukit Kepong area, well known to be mineralized, and he recommends a further investigation of this area.

Dr. Alexander, in dealing with anomalies located North of Sri Medan in West Central Johore, where iron ore mining has been carried on a relatively small scale, states that a number of prospecting permits have been issued in the Ma'Okil Forest Reserve and along the Lenga and Meda rivers, but little detailed prospecting has been done, although a deposit of manganese ore is known to exist.

In a general conclusion, Dr. Alexander expresses the opinion that it is unlikely that additional prospecting applications will result from the publication of the report. Most of the areas indicated as possibly being mineral bearing are already fairly well covered by existing applications.

CHINESE EYES ON TIBET'S MINERAL WEALTH?

In her evident determination to bring Tibet to heel and keep her there, Communist China is activated by more than purely political reasons, writes a Far Eastern correspondent. It is becoming increasingly clear that she has an acquisitive eye on Tibet's untapped mineral resources.

A special delegation sent from Peking to conduct a full-scale survey of the country reported: "We feel that Tibet has a brilliant future in economic construction. It is rich in minerals, many of which are rare, and precious metals. Its soil is fertile, it is well irrigated and it has rich hydro-electric resources."

Chinese sources have described Tibet as an "untapped treasure house, whose mineral deposits have never been excavated or even surveyed on any large scale in the past".

"Operation Grasshopper"

Canadian technicians will speed mineral resources development in South America, starting next month, through a 66,000-mile aerial survey of Surinam. Hopes are high for this new development programme, known as "Operation Grasshopper", since first studies show possibilities of mineralization similar to the rich Canadian Shield.

The air survey is being carried out by Canadian Aero Service Ltd., Ottawa, and its affiliates, at a cost close to \$700,000. The joint resources of the world-wide air survey companies will permit the survey to be completed at an accelerated pace, in about one year's time.

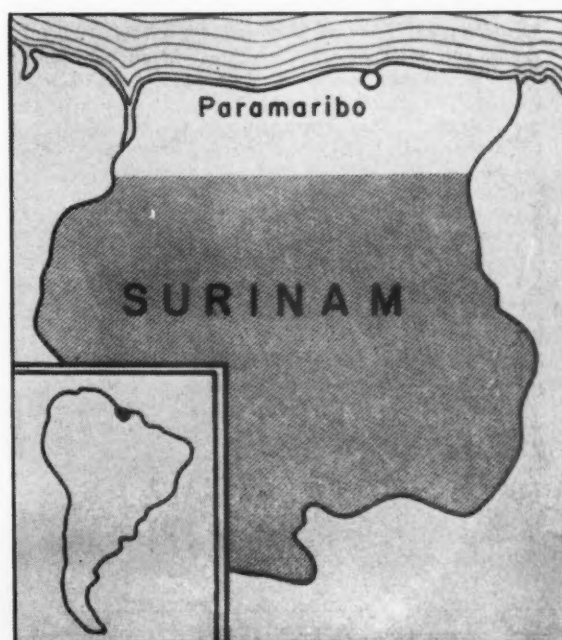
"Operation Grasshopper" calls first for photogeological studies of 80 per cent of Surinam. This evaluation will guide the extensive airborne geophysical surveys of the country. Later the combined geological and geophysical information will lead to drilling of promising areas.

It is hoped to complete this big survey programme in a year, given favourable flying weather. It is thought that iron, uranium and other major minerals may be found in this area.

"Operation Grasshopper" is a four-pronged attack on the problem:

- Selection of prime target areas by air surveys;
- Helicopter airlift will deliver bulldozers to interior jungle areas to hack out air strips for central supply bases;
- Fanning out from these supply bases, helicopter landing areas will be cut out of the jungle; and
- Ground parties will move in for detailed studies.

About 80 per cent of Surinam (shaded area) will be covered by the photogeologic study and airborne magnetometer survey





THE BUSHVELD IGNEOUS COMPLEX

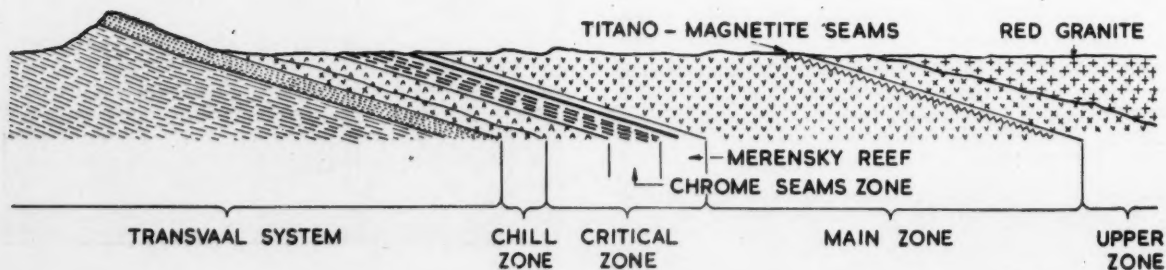
A vast composite body of plutonic and volcanic rocks in the central part of the Transvaal, the Bushveld igneous complex includes the platinum reef worked by Rustenburg Platinum Mines Ltd., constituting the world's greatest reserve of the platinum metals. This article, by C. A. Cousins, M.Sc., Johannesburg Consolidated Investment Co. Ltd., describes the geological and economic aspects of this unusually interesting formation. The article is reproduced from Platinum Metals Review by permission of the publishers, Johnson, Matthey and Co. Ltd.

IN South Africa platinum occurs chiefly in the Merensky Reef, which itself forms part of the Bushveld igneous complex, an irregular oval area of some 15,000 square miles occupying a roughly central position in the province of the Transvaal.

The complex rests upon a floor of sedimentary rocks of the Transvaal System. This floor is structurally in the form of an immense oval basin, three hundred miles long and a hundred miles broad. The sediments forming the floor have been extensively altered by thermal metamorphism, indicative of the high temperature of the molten igneous rocks which solidified to form the complex. These rocks consist of a vast body of basic, magnesium-rich rocks, the silica content of which gradually, although not regularly, increases upwards. Overlying this basic zone, whose predominant rock type is either norite or gabbro, lie sheets of the red Bushveld granite.

The basic rocks are exposed, as outcrops, in three areas covering over five thousand square miles. Two of these areas lie at the eastern and western ends of the Bushveld and form wide curved belts, trending parallel to the sedimentary rocks which they overlie, and dipping inwards towards the centre of the Bushveld at similar angles. The western belt has a flat sheet-like extension reaching the western boundary of the Transvaal. The third area extends northwards and cuts outside the sedimentary basin. Its exact relationship to the other outcrops within the basin has not as yet been solved.

As the eastern and western belts contain the more important economic zones, attention will be confined to these in this article. The two curved inward dipping belts have been estimated to reach fifteen to eighteen thousand feet in thickness. Geologists divide them into four main



zones, namely the Chill Zone, the Critical Zone, the Main Zone and the Upper Zone.

The Chill Zone was formed by the earliest part of the igneous magma which came into contact with the sediments of the floor and was cooled rapidly. Its thickness is estimated to lie between five hundred and a thousand feet.

This Chill Zone grades into the Critical Zone, estimated to be from four to five thousand feet thick, in which the most valuable minerals are found. Within this zone is a remarkable sequence of layered rocks which, although obviously igneous in origin, show all the characteristics of an unusually regular sedimentary series.

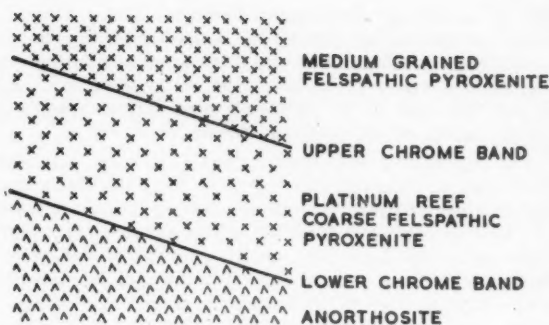
The rocks consist of alternations of pyroxenites (mainly magnesium-iron silicates), anorthosites (rocks consisting of almost pure felspar-sodium calcium aluminates) and norites (intermediate in composition between the pyroxenites and anorthosites). Layered within these rocks are regular seams of chrome ore, ranging in thickness from an inch to more than eight feet, while near the top of the zone occurs the platinum-carrying Merensky reef, named after Dr. Hans Merensky, the brilliant geologist responsible for its discovery.

The Critical Zone

A remarkable feature of the Critical Zone is that individual bands can be traced around the entire outcrop of the complex. The chrome seams and the Merensky reef retain their individuality with only minor variations wherever they have been prospected, and boreholes show them to continue unaltered in character down to depths of three thousand feet.

Above the Critical Zone, eight to ten thousand feet of norite (or gabbro) is met. This is known as the Main Zone. Here the remarkable layering of the Critical Zone becomes inconspicuous or absent. At the top of the zone, layering again reappears with bands of titano-magnetite, one to six feet thick, lying on white anorthosite. These bands appear to be just as persistent as those of the Critical Zone.

The Upper Zone, less than a thousand feet thick, forms the uppermost portion of the zone of basic rocks. In this zone the rocks become richer in quartz and poorer in pyroxene. Above this we find the Red Granite out-cropping over five thousand square miles in the interior of the



complex. This rock is responsible for tin mineralization.

The area between the two zones of basic rock outcrops, both in the interior of the complex, and across its rim, is covered by sheets of the Bushveld granite and younger sedimentary rocks. In addition, outcrops of the Transvaal System rocks, which form the floor of the complex, are also found in the interior and their position has given rise to various interesting speculations.

The Merensky Reef

The platinum-carrying Merensky reef has been prospected over distances of 75 to 80 miles along both the eastern and western outcrop belts. Platinum values are persistent but in some areas values are consistently higher than in others.

It is this reef which is mined by Rustenburg Platinum Mines Limited at the two sections of its property, the Rustenburg section a few miles to the east of that town and the Union section some sixty miles to the north. The discovery of platinum in the Merensky reef in 1925 led to a considerable outburst of activity in platinum mining at a number of places where the reef outcropped, but this boom was short-lived and only two mining companies survived. These were merged in 1931 to form Rustenburg Platinum Mines Limited. In 1947 the Union Platinum Mining Company Limited was formed to work the Merensky reef further north, but in 1949 this company was amalgamated with the Rustenburg company and now constitutes the

On opposite page: Above is a trainload of platinum ore on haul at Rustenburg Platinum Mines. Below, an ideal geological section across the Bushveld igneous complex. The platinum-bearing Merensky Reef lies near the top of the Critical Zone

On this page: Above, shown between the diagonal lines, is an ideal cross section across the Merensky Reef. Below, alongside, charging for blasting on the Merensky in Rustenburg Platinum Mines



Union section of Rustenburg Platinum Mines Limited. Over the intervening period the output from this source has grown very substantially, and Rustenburg now constitutes the world's largest producer of the platinum metals, and in fact the only major producer whose prime activity is the extraction of the platinum metals.

The platinum is not found in the pure state, but is a composite of platinum and the other five platinum group metals, their relative proportions showing variations from one area to another. Platinum is the predominant metal, followed by palladium, with smaller amounts of ruthenium, rhodium, osmium and iridium, together with traces of gold. A proportion of the platinum is present as "native" metal, invariably alloyed with iron (ferro-platinum), while the remainder occurs as the arsenide and sulph-arsenide, sperrylite and cooperite. The ore invariably contains a few per cent of the sulphides of iron, nickel and copper. The nickel and copper are extracted as a by-product from the platinum concentrates, adding appreciably to the value of the ore.

Formation of the Reef

The Merensky reef in its typical section, is a coarsely crystalline aggregate of pyroxene and feldspar, with sulphide mineralization. It underlies a finer grained bank of a similar rock and rests with an extremely sharp contact on a band of white anorthosite. Thin seams of chrome ore, usually less than an inch thick, are found on both the top and bottom contacts. In some areas, however, one of these chrome seams may be absent. The ore within or adjacent to these chrome bands is generally the richest in platinum. A feature of the reef, which makes for easy mining, is its regularity in dip and strike, the evenness of its values and its constancy in thickness.

Dykes and faults are rare in the two mines controlled by Rustenburg Platinum Mines Limited. The only underground complication is the occasional occurrence of what are known as "potholes". These are roughly elliptical areas in which the reef suddenly becomes displaced into the footwall and is often somewhat disturbed and broken. The reef can, however, be mined out in a considerable proportion of potholes. Their origin is still a mystery.

The reef has been proved by drilling down dip on the Rustenburg and Union mines and their potential ore reserves are very considerable.

Economic Resources

In addition to the platinum content of the Merensky reef, which represents the world's greatest reserve of this metal and its sister elements, nickel and copper are being extracted as valuable by-products.

The chrome seams of the Bushveld, while of lower grade than the Rhodesian or Turkish ores, form the major proportion of the total known chrome reserves of the world. Their continuity in thick seams over scores of miles of strike and their persistence in depth as proved by deep drilling, make for easy and cheap mining.

The titanomagnetite seams of the Main Zone show the same persistency and continuity, but have not been exploited to date. Titanium is now assuming importance in metallurgy and there is little doubt that treatment of these ores will be attempted in the future. Contained in the titanomagnetite ore is a persistent fractional percentage of vanadium. The total reserves of titanium and vanadium in these iron ores must be very large.

It is obvious, therefore, that the ores of the Bushveld igneous complex occupy a prominent place in the world's mineral resources.

Cells for Electrolytic Production

THE production of hydrogen and oxygen by the electrolysis of water has seen many developments since the turn of the century in respect of the design and construction of the cells used. On the one hand, electrolysis is the most convenient means of preparation where both gases are required, such as in the case of the oxy-hydrogen flame, which is so extensively utilized today for welding, cutting, and brazing of metals. Alternatively, large chemical undertakings use the hydrogen in the synthesis of ammonia, and the oxygen in sulphuric and nitric acid manufacture, etc. One of the advantages of using hydrogen which has been prepared in this way is its freedom from catalyst poisons, which thus renders it best for hydrogenation processes.

Hydrogen is supplied here in cylinders of 110 and also 135 cu. ft. capacities, while oxygen cylinders are normally of 240 cu. ft. capacity. In cubic capacity, the output of hydrogen from cells in general approximates to twice that of oxygen. Hydrogen of 99.9 per cent purity costs 81 shillings per 1,000 cu. ft., with the oxygen cost 70 shillings at comparable pressures. As can be understood, efforts have been made to utilize the oxygen as fully as possible, instead of having it relegated to the category of a byproduct, as was done formerly.

Continuing the Tradition

The practice of installing electrolytic plant for hydrogen and oxygen production for large chemical undertakings, in some ways follows earlier industrial history, since chlorine and caustic soda were formerly made by separate processes, prior to the development of chlorine-alkali cells. (One large chemical combine here had several thousand Vorce cells installed by the Westvaco Chlorine Products Corporation, for this latter purpose.) These methods make for clean, efficient, automatic, and continuous production.

For hydrogen used in the synthesis of ammonia, several batteries of cells of different designs, including tank type and filter press installations, were included in the original plant of the Consolidated Mining and Smelting Company of Canada. These batteries have been superseded by batteries of the Trail cell, an improved design of unit developed by Cominco engineers, and all plant expansions have been based on this design since 1939. The plant at Trail is now stated to include over 3,200 of these cells, operating at loads up to 16,000 amps, for the production of some 35 tons of hydrogen per day. In view of the power obtained from a nearby hydro-electric scheme, it was claimed that production of hydrogen alone paid for itself in this instance. The hydrogen is used in the synthesis of ammonia, which in turn is employed in the manufacture of various fertilizer products based on the nitrate, phosphate, and sulphate of ammonia, besides ammonia solutions. The oxygen is consumed in a number of plants, notably those for the production of sulphuric and nitric acids.

Nature of the Cell Top Used

The characteristic feature of the Trail tank type of cell is the monolithic construction of the cell top wherein the gas collecting bells and gas chambers, electrode supports and

Production of Hydrogen and Oxygen

cell cover, are incorporated. This provides an electrically non-conductive unit, whereas other tank type designs when assembled require these separate parts to be insulated from one another. The electrodes, asbestos diaphragms and skirting, and the gas main connections are attached to the unitary top. A complete cell for the generation of hydrogen and oxygen is formed when this top with attachments is immersed in the electrolyte within the cell tank.

The cell top is made of electrically insulated material in the shape of a rectangular box, while the hollow interior is divided by a thick vertical partition into two compartments. These serve as separate collecting chambers for hydrogen and oxygen, while the electrodes are suspended and appropriately accommodated against the underside of the top unit by supporting rods which pass through this partition. A lengthy narrow slot, which serves as a gas collecting bell, is formed in this underside of the cell top. This slot, or inverted trough, is directly above and parallel to each electrode, and at right-angles to the vertical partition. Those slots above the cathodes emerge into the hydrogen collecting chamber, while the slots above the anodes open into the oxygen collecting chamber, but asbestos diaphragms prevent these gases from mixing.

A feature of this cell is that corrosion troubles are largely minimized, since the metal parts familiar with many other designs, such as gas bells, etc., are not present. Feed water for the cells is supplied to the tanks at one end of the battery, and is distributed by rubber-jointed glass mains supported on the cell-tops by brackets. As with other models, the flow of feed water from the mains is regulated at each individual cell. The electrolyte comprises a 28 per cent solution of potassium hydrate in distilled water, which latter purity is more or less essential.

The conductivity of the feed water, when conditions permit, should not be allowed to average more than 10×10^{-6} mhos. and should not exceed 20×10^{-6} mhos. Circumstances may necessitate that water of higher conductivity be used, but which is permissible, and does not adversely affect the relative advantages of this cell. Water consumption in the cells at 75 deg. C. is 53 lb. per 1,000 cu. ft. of hydrogen saturated at 25 deg. C.

Constructional Features of the Layout

The size of the cell tank is determined by the dimensions of the cell top, which vary according to the number and spacing of the electrodes. The number of electrodes per cell and the spacing between opposing electrodes may be varied, depending upon the requirements demanded by each installation, but otherwise the same basic design is adhered to in all modifications. For example, such cells are operating with 15, 17, or 21 electrodes, with appropriate face-to-face spacing between electrodes. Normal overall dimensions are 3 ft. 11 in. in length, 4 ft. 9 in. in height, and the width varying from 2 ft. 6 in. to 3 ft. 4 in., where the volume of electrolyte per cell ranges from 28 to 43 cu. ft. (174 to 267 gals.). The electrodes consist of two spaced steel sheets, spot-welded together, equipped with supporting rods, and terminals of nickel-plated copper, and although anodes and cathodes are of corresponding construction, the former are nickel-plated.

By C. C. DOWNIE

An asbestos diaphragm bag accommodates each anode, while the entire electrode assembly is enclosed within an asbestos skirting.

Mixing of the gases below the electrolyte level is forestalled by the asbestos diaphragms, the gases being accumulated in their respective collecting chambers in the cell top, i.e. above the electrolyte. The quality of the asbestos diaphragms determines the purity of the gases under normal operating conditions, while within the cell top there is no opportunity for them to become contaminated.

All cells are arranged in rows to form a battery. The two gases from each respective row are collected by separate hydrogen and oxygen mains located immediately above the cells. Each main is connected to its respective gas collecting chamber in each cell top by a short metal T, screwed into a coupling embedded in this top, and which communicates with this chamber. The gas mains are fastened to manifold pipes, at the end of each row, through which the gases pass to their respective coolers and from thence to gas holders.

Considerations of Efficiency

Current efficiency in all modifications of this cell is claimed to approach 100 per cent because the composition of the cell top is non-conductive, and internal current leakages are negligible. Hence the d.c. power consumption varies directly with the voltage, but power consumption and voltage depend upon a number of features such as spacing of electrodes, selected current density, and choice of potash or soda electrolyte. Specific figures depend on the numerous variables involved and the differing circumstances of each installation, although generally the power requirements are relatively low. In some quarters there is a trend towards higher battery ratings, and this design is adaptable to a wide range of different loads. The rate of production per cell at 10,000 amperes is 2.46 cu. ft. per min. of dry hydrogen at N.T.P. which corresponds to 19.9 lb. of hydrogen per day.

In conclusion, this relatively simple design of cell is used where the production of hydrogen and oxygen is consistently maintained at high level, and which demands continuous full load operation. Batteries of these units have been installed in different parts of the world.

AUSTRALIAN ALUMINIUM—II

Programme of Development of the Australian Aluminium Industry

PRIOR to 1955 bauxite was known to occur in almost every state in Australia. However, with the exception of the Gove area in Arnhem Land, the tonnage of individual deposits was small and the grade unattractive. Since the discovery of Weipa, the Australian reserves of economic grade bauxite have reached world class. The development of these bauxite deposits involves a major undertaking requiring considerable technical resources and finance. Before either the alumina stage or the final metal reduction stage is reached, many problems have to be overcome.

The production of aluminium metal requires major supplies of cheap electric power. The chief sources of power being investigated by Comalco are :—

(a) *New Guinea Hydro-electric Potential*: Previous work carried out by New Guinea Resources Prospecting Co. Ltd. has indicated that two sites in the Purari River could yield at least 800,000 kilowatts of electricity, and suitable harbour and factory sites have been indicated at Delena on the Papuan coast some 60 miles north-west of Port Moresby.

To prove these resources, Comalco is currently carrying out a detailed survey of the proposed sites so that an accurate economic assessment can be made of the power potential of the area.

(b) *Blair Athol Coal*: A five-year option has been secured by Comalco over the Blair Athol coalfield in the central coastal region of Queensland. This field, which is 130 miles in a direct line from the coast, contains a very large deposit of black coal capable of being worked by cheap opencut methods. Reserves have been estimated at approximately 180,000,000 tons of good quality coal.

Investigations are proceeding into the proving of the coal reserves and the economic assessment of the cost of generating power at Blair Athol, or alternatively, bring the coal to a suitable site on the coast for power generation.

Because of the large tonnage of general cargo, raw materials and products which would have to be carried by sea to and from any alumina plant set up in the Weipa area, an all-weather port, capable of handling large-draft vessels has to be considered. Prior to the commencement of the present operations at Weipa, the only available hydrographic chart of the Gulf of Carpentaria was one based mainly on the work done by Matthew Flinders in 1803. To determine the feasibility of establishing a harbour at Weipa, Comalco has carried out a detailed hydrographic survey of the estuaries of the Mission and Embley Rivers at Weipa, and their seaward approaches in Albatross Bay.

In addition, detailed studies have been made of currents, wave amplitude, water densities, bottom sediment composition and tide measurements. The vast amount of data compiled from these studies is now being integrated into a large-scale model of Albatross Bay, and the river estuaries. This work is being done in Holland by a firm of experts in harbour design. The model of the proposed harbour will be subjected to a series of tests in which the tides, currents and wind conditions at Weipa will be simulated.

The variations in weather, particularly wind velocity and possible frequency of cyclonic disturbances, are important factors in the design of harbours, industrial plants and townships. Although limited weather information has been recorded by the various missions over the past 30 years, no really systematic records were available on the general area.

This is the concluding part of a paper presented by H. J. Evans, chief geologist, Commonwealth Aluminium Corporation Ltd., at the Symposium held in Brisbane on July 16 and 17, 1959, by the Australasian Institute of Mining and Metallurgy, Southern Queensland branch, the Australian Institute of Metals, Brisbane branch, and the Royal Australian Chemical Institute, Queensland branch

To obtain this essential information, Comalco have established a fully equipped meteorological station at Weipa, and critical information is now being compiled continuously throughout the year.

To operate an alumina plant and supply the needs of a township at Weipa, will require very large quantities of fresh water, amounting to several million gallons per day. Three sources of water are currently being considered, namely—(1) a shallow aquifer approximately 30 ft. below the surface; (2) a deep artesian aquifer at a depth of 3,000 ft. (flow 500,000 g.p.d., temperature 168°F.), and (3) the Wenlock River.

The shallow aquifer, which occurs below the bauxite, offers possibilities of supplying at least the initial needs of the industry, and testing of this aquifer is now being undertaken by means of boreholes on which draw-down pumping tests will be carried out. This source of supply, however, must necessarily be considered a short term prospect, as the aquifer could be seriously affected by a prolonged drought. The deep aquifer, at 3,000 ft., though capable of producing fairly large volumes of water, has the disadvantage that the water contains considerable quantities of dissolved salts. This aquifer has been tested by a deep bore, drilled in 1957. The economic elimination of the dissolved salts is being considered, but it is doubtful if this aquifer can be considered as an immediate source of fresh water.

The Wenlock River has been investigated, and offers an adequate supply of good water for both the alumina plant and township requirements. This water supply scheme would, however, involve approximately 40 miles of pipeline, and a substantial dam near the head of the river.

The geographical location and isolation of Weipa stresses the importance of supplies of fresh food to a township at Weipa. Although basic supplies will no doubt be available through normal shipping, the importance of local supplies must be considered, and a study has been started into the agricultural and pastoral potential of this section of Cape York Peninsula.

The development of a fully integrated aluminium industry is a major undertaking and substantial progress has been made both in field work and in the basic planning and technical investigation required for a project of this magnitude.

By its very nature, the project is long term, and much more has yet to be accomplished before the final construction phase can be undertaken. However, those associated with it confidently believe that the resources available in these northern parts will, in due course, enable Australia to assume an important role in the world's aluminium industry.

ECONOMICS OF THE MINERAL INDUSTRIES

EDITED by Edward H. Robie, formerly secretary of the American Institute of Mining and Metallurgical Engineers, this publication consists of a series of articles by leading American specialists in their respective fields. The result is a truly comprehensive survey of mineral economics, which is not only authoritative but also of outstanding interest—two qualities which do not invariably co-exist. Though geographically the principal emphasis is on the U.S., numerous references are made to other countries and most articles are essentially international in their treatment and scope.

The 18 articles cover virtually all aspects of mineral economics, ranging from the significance of the mineral industries in the economy to the cost of acquiring and operating mineral properties; from mine financing to marketing and from the changing patterns of supply and demand to the role of minerals in national and international affairs. There are (*inter alia*) chapters on mineral titles and tenure, taxation of mineral properties, Government aid and regulation, conservation and stabilization, labour-management relations, and industrial research. Finally, the outlook for the future is discussed in an article which emphasises man's dependence on the minerals industry, but at the same time stresses that minerals have been and will continue to be but one of several tools of man in his march towards unknown and unpredictable goals.

From such a wide range of material it is possible for the reviewer to present no more than a few random gleanings. Particularly valuable, in view of some widespread misconceptions, are the observations of Charles White Merrill on minerals as capital. Operating mines, it is pointed out, represent a form of national production, but at the expense of reserves. This "wasting" nature of the extractive mining industry seems to have depressed some who speculate on mineral affairs without giving due weight to the fact that it is minerals-in-use, not the use potential of mineral resources, that serves mankind.

Merrill goes on to state that in practice submarginal ores automatically replenish the store of profitable ores from the standpoint of the world economy as the better ores are extracted. Thus there is an endlessly retreating line dividing the profitably minable from the sub-marginal ores in nature. It is, in fact, in the nature of mineral economics that society adjusts itself to what is left and pays the cost of mining the lower grades remaining, uses substitutes, or goes without. Moreover, the quantity of any mineral available is vastly increased by small decreases in the grade of the leanest ore that will be mined. Thus small improvements in mining or treatment methods often can make available for profitable exploitation vast supplies of formerly submarginal material.

Particular significance is seen in the fact that the capital investment required for working low-grade ore bodies usually is large per unit of output. Long periods of production are needed to provide a return on the investment. Only in countries of political and industrial stability can the financing of such enterprises be arranged. On the other hand, large, long-term productive mines have a stabilizing effect on government and society in their provision of steady employment, tax revenue, dependable raw-material supply, and other benefits. It is concluded that increasing political and social stability in the underdeveloped areas of the world would offer unusual

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opportunities for expanded mineral supplies, higher standards of living, and a firm foundation for extended peace.

On the other hand, numerous difficulties are also involved in foreign minerals enterprises as Elmer W. Pehrson points out in his article on minerals in national and international affairs; among them being fear of nationalisation and expropriation, taxation, and the widespread practice of governments to force foreign-owned enterprise to employ native talent and management. Labour legislation in some countries is a deterrent to mining operations. One difficulty appears to be in connection with the growing philosophy that once an employee is hired his position on the payroll becomes an inalienable right. This is reflected in labour laws by requiring the payment of large indemnities to displaced workers. Consequently a reduction in staff dictated by market conditions or by depletion of ore bodies is frequently prohibitive, because of the costs involved. Sometimes, notably in Mexico and Venezuela, this situation has been a major factor in government taking over foreign-owned mining enterprises.

Advancing labour costs are particularly destructive of production in those districts where the depth of mining is increasing and the grade of ore diminishing. The great silver mines of Guanajuato and Pachuca in Mexico, which for four centuries were among the world's leading producers, are now government-operated and contributing only a fraction of their former outputs.

Despite all difficulties the direct U.S. private mineral investment abroad at the end of 1957 totalled over \$11,600,000,000. This was 46 per cent of all U.S. private direct foreign investment, the production and distribution of minerals thus being by a sizeable margin the most important function of American capital working in other countries.

As to the future, W. C. Schroeder and Richard H. Mote, in discussing Dimensions and Changing Patterns of Supply and Demand, emphasise that a growing world population, plus a rising living standard for much of the world's population, make imperative a continued expansion of world mineral output. Many industries, such as fuels, metals and other basic commodities, will be struggling with the problem of finding raw materials to meet the demands of the future. Resolution of these problems will become more and more a matter of the successful application of technology.

Clearly, the world is not going to run out of any of the basic industrial raw materials in the sense that the supplies will be completely exhausted. Mankind must, however, develop new techniques for using lower and lower grade materials and constantly seek new sources of supply. Substitutes must be utilized, and the means for discovering the earth's hidden wealth must be sharpened. Assuming adequate effort in these directions, the world should be able to meet its raw material requirements for centuries.

Machinery and Equipment

A.E.I. Helps in an Emergency

Because of their knowledge and experience in industrial and mining communication problems, A.E.I. Electronic Apparatus Division engineers were called in following a recent winding incident at Hem Heath Colliery, West Midlands Division, N.C.B. The colliery, the deepest in England—3,408 ft.—had been put out of action when three of the four cages crashed to the bottom of the shaft while dirt was being wound.

The A.E.I. Electronic Apparatus Division engineers took with them their "Clearcall" (certified) cage communication equipment, and had this working within four hours of the request being received at New Parks, Leicester. This provided two-way speech communication between the bucket and the pit head, using only the winding rope as an electric conductor for transmitting signals as descents were being made to inspect damage and recover equipment. Coal Board representatives present expressed themselves as being impressed with the equipment.

The electrical winding gear at the colliery was manufactured by A.E.I. Heavy Plant Division, Rugby, and was not damaged.

AN OVERDRAIN CLASSIFIER

The Overdrain classifier manufactured by Hardinge Co. Inc., United States, is suited for operation in all those cases where either the screw or rake type classifier is used. It is simpler in construction and has other features that neither these nor any other types of classifying devices possess. It consists of a rectangular

lar tank with sloping bottom. The feed is introduced in the deep end, at some distance away from the overflow point. The overflow is a weir of variable height located at the deepest portion.

In provision of the overdrain action, the scraping device consists of a slowly moving endless belt of rubber or special fabric for use when corrosive or acid liquids are employed. To the belt are bolted metal scraper flights, the same width as the belt. Holes are located in the belt, just above each scraper blade, to form a discharge point for the entrapped liquid and fines.

To insure positive entrapment of the moving solids and pulp scraped by the blades, stationary shrouds are set close to the sides of the belt. Moving pockets or compartments are thus formed, with the only outlet being the holes in the belt, except at the ends.

The advantages of the classifier are claimed to be that very low maintenance and less than half the power of other standard screw or rake type classifiers are required. The teeter column at the overflow end insures efficient separation. Fines and slimes once liberated from the sands are prevented from re-mixing with the sands. A relatively dry sand product is obtainable. Indeed, sands can be washed clean of excessive fines by an independent and controlled action. By the same means, one liquor may replace another with a minimum of dilution or waste.

The machine is said to be ideal for operating in closed circuit with grinding mills, as normal operating slope is greater than in standard mechanical clas-

sifiers. Further, it is efficient in the field of washing and minimizes the amount of replacement liquid required to do a thorough job of cleaning. It can be started after power failure or full load shutdown without delay or dumping the classifier tank. Finally, it occupies less floor space than classifiers of equivalent capacity and has greater sands discharge capacity for a given tank width, while inspection of all parts is easily made and means of control are simple.

A "CLOVER LEAF" MAGNET

Rapid Magnetic Machines Ltd., have introduced a new "Clover Leaf" lifting magnet to facilitate the handling of coiled mild steel strip and the like. The new unit consists of a number of magnets mounted on a common framework, and adjustable so as to cover various coil diameters.

Hitherto it has been necessary to employ large diameter magnets to cover the wide range of coils, which has proved



unwieldy and uneconomical. The unit illustrated provides not only an economical answer to the particular problem, but also removes the possibilities of damage, common when using slings and mechanical grabs.

A NEW MATERIAL

Orkot is a new material made of fabric reinforced resin developed by United Coke and Chemicals Co., Ltd., a subsidiary of The United Steel Companies Ltd. Rolling mill bearings made from Orkot were placed on the general

Alongside, at left, short type Hardinge Overdrain classifier. Unit is seen from overflow end, with hydraulic lift shown. Above, at centre of page, the new lifting magnet by Rapid Magnetic Machines Ltd.



Alongside, at right, the Prosper portable diamond core drill by Craelius. Below, in centre of page, the new inbye mining pump manufactured by Joseph Evans and Sons (Wolverhampton) Ltd.

market after four years' trials in the Companies' steel mills. The performances obtained in this field indicated that wider applications existed and extensive trials were carried out in a variety of industries. It was found, in many cases, that power savings, increased bearing life and increased shaft life could be obtained by using Orkot bushes and bearings. It also became clear that there was a real need in many branches of the engineering industry for an improved bearing material and some of the many applications in which the new material is being used is in electronic metal detector-conveyor rolls by the Santon Mining Co. Ltd., on a hook coil conveyor at Templeborough Rolling Mills Ltd., on power shovels, and the like.

NEW INBYE PUMP

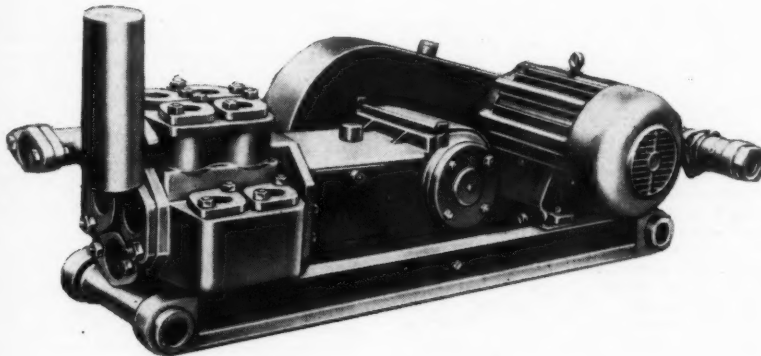
A generally difficult mining task is that of dealing with relatively small quantities of water which accumulate at or near the coal face. Such water frequently contains impurities, solids and gritty matter in suspension, and the pump must also be capable of working on snore. The pump must stand up to

with individual valve boxes having separate covers. Valves can either be of the ball or rubber sealed disc type. The pump piston has special Fluon sealing rings to reduce heat generated when working on snore to a minimum. Removeable liners are provided and materials of construction can be adapted to suit specific requirements. A simple chain transmission drive between the motor and pump crankcase enclosed in a heavy gauge oil bath case is used. The motor is mounted on the pump base at the back of the crankcase.

Two basic sizes of pumps are at present available and each can be fitted with three different bore interchangeable liners. The pumps are of relatively short stroke so that internal gearing in the crankcase is dispensed with whilst retaining a low piston speed. The capacity range is from 20-80 g.p.m. and the maximum head is 460 ft.

SHALLOW CORE PROSPECT DRILLING

Craelius has recently announced the Prosper portable diamond core drill. The tool is presented as being ideal for shal-



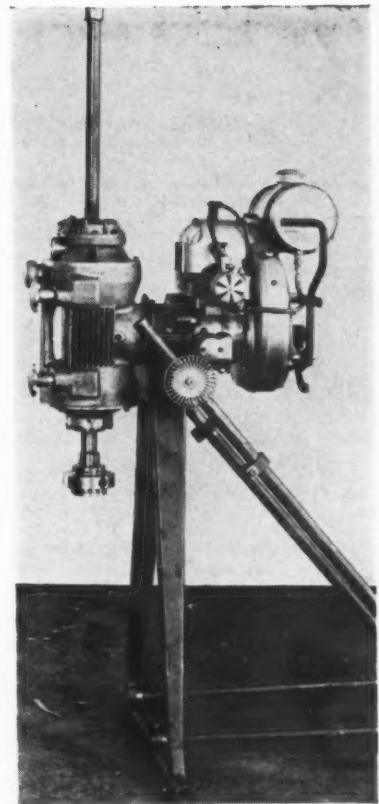
rough usage and be capable of working for long periods with minimum attention. The unit will frequently have to work in a very confined space, the limitations of height and width being particularly acute. The necessity for frequent and expensive replacement of wearing parts must as far as possible be avoided.

It was with these problems in mind that the inbye pump manufactured by Joseph Evans and Sons (Wolverhampton) Ltd., was designed. The pump is a totally enclosed duplex piston type. The crankcase and skid type base are of integral fabricated steel construction, combining extreme rigidity and low weight. The lubrication system to the crankcase is by splash, and is entirely efficient with either direction of rotation and with the pump at a slight inclination from the horizontal. The crankshaft runs in roller bearings, and the cross-heads have easily renewable guides. The crankcase has a suitable inspection cover and is completely sealed against ingress of dirt and dust.

The liquid end is of the side pot type

low core prospecting, where the overburden layer has a limited depth. Provided with the Craelius patented feed and speed regulating system, the Prosper is of completely closed construction to resist dust and moisture, while at the same time all shafts run on ball bearings. Bit speed control, operated by a hand wheel, admits of continuous regulation from zero to maximum revolution speed while feed control, likewise operated by a hand wheel, admits of continuous regulation from zero to maximum feed rate. There is, moreover, full interchangeability of the prime movers (petrol, electric or air motors), low overall weight, the machine being easily disassembled in four parts, swivel head, spindle, motor and frame, of which the heaviest weighs about 30 kg. The swivel head and prime mover are carried in rucksacks.

The standard pump unit for the Prosper consists of a Craelius flush pump type SP 55 by 20, petrol driven and weighing 36 kg. Drilling equipment consists of rods with couplings of high-grade cold-drawn precision steel tubing;



core barrels of double tube, swivel type, bottom discharge construction; and diamond bits and reamers.

Feed range is adjustable from 0 to 26 m.m./100 revs. of spindle. Spindle bit speed is adjustable from 0 to 1,800 r.p.m. at 3,600 r.p.m. of engine. Spindle feed length is 500 m.m., inner dia. 25 m.m. and spindle swivel range 360 deg.

WINDER FOR PIT MODERNIZATION

A further example of the growing use of mercury arc converters for large reversing drives is given by an order for a 1,750 h.p. mine winder received by the Mining Division of English Electric from the National Coal Board. The equipment will be installed at Newstead Colliery in No. 4 (Alfreton) Area of the East Midlands Division. This forms part of the current five-year reconstruction scheme, designed to increase the capacity of the pit to more than 1,000,000 tons annually.

The new winding arrangements consist of a conventional double drum winder, having a payload of seven tons, with a capacity of 400 tons per hour from the High Main level at a depth of 750 ft. The 1,750 h.p. d.c. motor is fed from a 3-phase, 50 cycle, 11,000 volt supply via 1,085 kW, 750 volt converter equipment. This consists of one oil-immersed 12-phase converter transformer, four grid-controlled mercury arc converters with associated control panels, and a high speed d.c. circuit breaker. The system is arranged for closed loop manual control.

Robey and Co. Ltd., of Lincoln are the sub-contractors for the mechanical equipment, which includes their latest system of high-pressure unit brakes.

MINING MISCELLANY

A new Dutch-owned coal mine, east of Roermond, to be named after Crown Princess Beatrix, will start production in the middle of 1962. Two years ago the Dutch and German Governments signed an agreement allowing the Beatrix mine to extend its underground activities under German territory, raising its estimated annual production to 1,800,000 tonnes of coal by 1967. When fully operating the mine, which will cost between 200,000,000 and 300,000,000 guilders, will employ more than 5,000 people. Construction of the first shaft started in May, 1955. The new Beatrix mine is to replace another Dutch State mine, the Wilhelmina, around 1970, when the latter's production is expected to decrease.

Canada's long awaited National Energy Board has at last been appointed. The chairman is Mr. Ian McKinnon, who has been chairman of Alberta's Oil and Gas Conservation Board from its inception. The vice-chairman is Dr. Robert Howland, now serving as a member of the Borden Royal Commission on energy prospects. The other members are Mr. Jules Archambault, a Montreal engineer; Mr. H. Lee Briggs, a former general manager of the Winnipeg hydro-electric system and the British Columbia Power Commission; and Mr. Douglas Fraser, who has been head of the Federal Government's Energy Studies Branch, and was principal adviser on the new National Energy policy. Mr. V. C. Wansbrough, vice-president of the Canadian Metal Mining Association,

An example of the application of a Crompton Parkinson PXA alternator is illustrated in this Davey Paxman & Co. Ltd. mobile diesel alternator set supplied to Selection Trust Ltd. This equipment will be used in Sierra Leone at various diamond mines while the existing site electrical plant is being overhauled. The engine is a "V" type 8 RPH diesel of 7 in. bore x 7½ in. stroke with a site rating of 329 b.h.p. at 1,500 rev./min. The unit is completely self-contained, being radiator cooled and carrying its own fuel tanks. The engine is fitted with a Teddington Industrial Equipment Ltd. control unit which automatically shuts down the engine in the event of the oil pressure falling below 30 lb./sq. in. or the oil temperature rising above 180 deg. F. Air brakes are fitted and four mechanical jacks support the weight when the set is in operation. The C.P. PXA alternator is rated at 250 kVA, 1,500 rev./min., 3 phase, 50 c/s, 440 V, 4 wire, 0.8 power factor, and is direct coupled to the engine flange. An Isenthal voltage regulator is direct coupled to the exciter. The control cubicle is floor-mounted and the triple-pole oil-immersed circuit breaker is rated at 400 A, 11 MVA.



speaking on behalf of uranium producers, has expressed surprise and disappointment that an atomic energy expert was not appointed a member of the new council.

In its nickel-cobalt research programme for the fiscal year 1960, which began on July 1, the Bureau of Mines, U.S. Department of the Interior, will emphasize processes for the development of the technically difficult separation of nickel from cobalt, the preparation of extremely high-purity metals, and methods for recovering nickel and cobalt from high-alloy scrap materials.

In November, 1958, the Bureau of Mines of Overseas France began surveying the "Chaines des Mamelles" iron-ore deposits in Cameroun, about 40 km. south of Kribi and only 7 km. from the coast. According to Bureau officials, the reserve is estimated at 100,000,000 tonnes. Exploration has not been completed, however, and final results of the studies will not be known until late in 1960. Actual test-drilling was not begun until April, 1959. All the ore examined has averaged 40 per cent iron. The European Coal and Steel Community, which contributed Fr.11,500,000 to the Bureau operations at Kribi in 1957-58, increased its participation to Fr.36,000,000,000 in 1958-59. It is reported that the Bureau and ECSC are studying a plan providing for the creation of an iron prospecting syndicate in Cameroun. Financing would be divided equally between the two organizations.

A Danish-Swedish consortium is to be formed to prospect for molybdenum in East Greenland. It will consist of the East Asiatic Co., Mr. Knud Lauritzen, the Oresund Cryolite Co., Danish Arctic Contractors, and two Swedish concerns, Boliden and Stora Kopparberg.

The Nova Scotia Mines Department has announced the discovery of workable deposits of beryllium on the Province's south shore. According to Dr. J. P. Nowlan, Deputy Mines Minister, enough has been found to justify private capital undertaking exploration work.

The National Coal Board has accepted an invitation from the Czechoslovak Minister of Mining and Power to visit mines and research establishments and to have discussions with mining engineers and experts in that country. The delegation will be led by Mr. H. E. Collins, the Board member for production and reconstruction. It will leave London Airport for Prague on Monday, August 24, and is due to arrive back on Thursday, September 3. A party of Czechoslovak mining engineers visited Britain in March this year.

Owing to an omission of detail in the Ransomes and Rapier advertisement in our issue of July 17, we should like to make it clear that NCK-Rapier are now producing a full range of heavy-duty excavators and cranes in the ½ to 4 cu. yd. range. These are backed by the combined experience and technical know-how of two of Britain's leading excavator makers, whose after-sales service keeps every machine at peak capacity throughout its long life. The offices of the NCK Rapier Sales Co., Ltd. are at 32 Victoria Street, London, S.W.1.

PERSONAL

Lord Baillieu, president of the Dunlop Rubber Co. Ltd., has accepted the nomination of the Council of the British Institute of Management for election as its first president at the annual general meeting in October.

Mr. A. H. Kellett, at present general manager, No. 2 Area, Durham Division of the National Coal Board, has been appointed deputy chairman of the Durham Division, as from September 14. Mr. Kellett succeeds Mr. D. E. Baird, who was recently appointed director of the British Coking Industry Association.

Holman Brothers Ltd., announce the appointment of Mr. James L. Ritchie as sales director, with responsibility for the direction of the Holman Group's sales organization at the Camborne headquarters and in the U.K. and overseas. He has become an associate director of Holman Brothers and is based at Camborne. Mr. J. F. Holman, who recently became joint managing director of the company, had hitherto been responsible for group sales direction covering the products of the parent company as well as those of the subsidiary companies, Climax Rock Drill and Engineering Ltd., Distructor Co. Ltd., Maxam Power Ltd., and Goodyear Pumps Ltd.

Metals and Minerals

New Uses for Minor Metals

It is indeed an unrewarding metal which can find no uses in this era of electronics, nucleonics and guided missiles, with its ever-growing demand for materials capable of meeting more and more highly specialized and exacting needs. An illuminating insight into the broadening horizons for a number of metals formerly of little or no commercial significance is given by the Bureau of Mines, U.S. Department of the Interior, in its review of Minor Metals in 1958.

U.S. domestic production and consumption of caesium and rubidium compounds increased several fold in 1958. In addition to established applications, large quantities were consumed for experimental purposes in developing new chemical, metallurgical and electronic uses. New uses gaining attention during the year included: a caesium plasma thermocouple for direct conversion of heat to electricity; a new photomultiplier tube using caesium telluride, another photomultiplier tube containing a caesium-antimony dynode, time-and-frequency standard devices containing caesium and a rubidium magnetometer. Potential uses for the elements include: Fuel in ion rocket engines, catalysts, heat-transfer systems, piezoelectric instruments, organic-synthesis intermediates, and in alkali storage batteries.

Caesium and rubidium were priced at \$1.10-\$5.00 per gram. High-purity compounds sold for \$0.16 to \$1.00 per gram.

Alcoa, Anaconda and Eagle-Picher produced gallium, which was quoted at \$3 per gram in 1,000 gram quantities and \$3.25 per gram in smaller quantities. No new large uses for gallium were reported in 1958. Gallium arsenide had potential use in the field of electronics. Research workers of the Bureau of Mines used gallium as a substitute for mercury in obtaining precision pressure-volume-temperature measurements in petroleum research.

As is well-known, the introduction of midge germanium semiconductors has radically changed the design of many electrical and electronic appliances. During the past decade germanium also played an important role in revolutionizing miniaturization and in the development of new technology in ultra-high-purity metallurgy. More than 45,000,000 germanium diodes, transistors and rectifiers were produced in the U.S. during 1958 with an estimated value of \$27,000,000. The volume of U.S. domestic production is not available, but it is indicated that output of germanium from primary raw material sources dropped sharply during 1958. A decrease in requirements resulted from improved technology and more efficient processing.

Extensive studies of the physical and chemical properties of germanium led to the development of several new applications in 1958. Germanium has been found to be a strong catalyst in speeding chemical reactions at extremely low temperatures. The use of germanium as an ultra-sensitive infra-red detector is expected to have widespread use. The detector is said to be sensitive to 0.000000002 of a watt of radiation. A

germanium resistance thermometer capable of recording accurate measurements of extremely low temperature will probably be used for outer-space temperature measurements.

The American Smelting and Refining Co., produced indium metal and compounds, and Anaconda indium metal. Production and shipments were each lower than in 1957. The Indium Corporation of America manufactured indium rod, wire, foil, fabricated shapes, solders, and other products for industrial use. The largest use for indium was in electronic devices. Other uses were in bearing and in special alloys.

Rhenium was produced by Chase Brass and Copper Co., a subsidiary of Kennecott, and by the Department of Chemistry, University of Tennessee. The University quoted rhenium at \$2.50 per gram in quantities up to 100 grams and \$1.75 per gram in larger quantities. Rhenium was used for filaments in mass spectrographs. The metal had experimental uses in electronic equipment.

High-purity silicon production and consumption continued to increase in 1958. U.S. production capacity was increased about threefold. An estimated 50,000 lb. of high-purity silicon was produced in 1959 and 45,000 lb. was consumed. From this, approximately 3,500,000 transistors and 26,200,000 diodes and rectifiers were made. Additionally, about 20,000 lb. of solar-battery grade silicon was produced, but only about 7,000 lb. was consumed. This element has been increasingly used as a rectifier since early in 1958, when silicon of about one part per 1,000,000,000 total impurities became available commercially. Continued expansion of U.S. production facilities is in prospect for 1959, despite apparent over-expansion in 1958, while an increased consumption of high-purity silicon over that of 1958 is also anticipated.

Thallium was produced only by the American Smelting and Refining Co. About the same quantity of thallium metal and compounds was shipped in 1958 as in 1957. Thallium metal sold for \$7.50 per lb. Thallium sulphate, used as an insecticide, was the principal use.

RECORD ALUMINIUM PRODUCTION IN U.S.

The Commerce Department has reported "all time peaks" in U.S. aluminium production and distribution for the second quarter and the first half of 1959. New supply of crude aluminium from all sources in the first half of this year amounted to 1,274,000 s.tons compared with the first half 1958 supply of 1,036,000 tons. It was 8 per cent above the previous peak of the first half of 1956.

U.S. primary output in the first half of 1959 was 942,500 s.tons, 10 per cent higher than the 1956 peak, and compares with 762,500 s.tons in the first half of 1958. Primary imports totalled 104,500 s.tons in the first half of 1959, and included 71,000 s.tons from Canada. Imports of semi-fabricated shapes "more

than doubled". Shipments of products to consumers in the first halves of 1959 and 1958 respectively were 1,240,000 and 805,500 s.tons.

Second quarter 1959 shipments to consumers amounted to 700,000 s.tons, 30 per cent above the first quarter of 1959 and 28 per cent higher than the previous peak in the first quarter of 1956. Shipments of metal to U.S. Government stocks, including imports, fell off sharply in the first half of 1959 to 41,000 s.tons compared with 251,000 s.tons in the first half of 1958.

Although demand was high in the second quarter of this year, with prices steady and inventories being built up in face of the strike threat, most of the increase was attributed to the growing use of aluminium.

Shipments of bauxite from the Dominican Republic, which started in January this year, have so far totalled 189,000 tons. Alcoa has spent \$14,000,000 in developing the 60,000,000 ton deposits.

QUICKSILVER DROPS SHARPLY

The downward movement in quicksilver has been sharply extended with a drop of £2 10s. to £71 10s. per flask ex-warehouse London. About four months ago the price stood at £79 per flask. A certain amount of metal is available of Mexican, Chilean and Peruvian origin, and sellers are finding the market un-receptive.

WOLFRAM MOVES HIGHER

After remaining stable for several weeks at 94s. 6d.-99s. 6d. per l.ton unit c.i.f. Europe, London wolfram prices have again been improving and are now quoted at 97s.-101s. This improvement is attributed to a broadening of demand, which presumably reflects the brightening outlook for the steel industry in Britain and Europe, and also, of course (apart from the strike situation), in the U.S. With the supply position little changed, the outlook for wolfram producers is becoming distinctly more encouraging. Even a prolonged standstill in the U.S. steel industry is unlikely to result in more than a temporary setback in demand, since any loss in the output of special steels would presumably be made good when normal working was restored.

BERYLLIUM PLANT EXPANDED

The Beryllium Corporation has completed expansion of its beryllium metal fabrication division at Hazleton, Pennsylvania, adding two new vacuum hot presses to the single furnace previously operating. The expansion was needed to meet increased demand for beryllium metal components from aircraft, missile and nuclear users. The new units will allow production of beryllium metal pieces from 6in. up to about 45 in. dia. by 60 in. long.

COPPER • TIN • LEAD • ZINC

(From Our London Metal Exchange Correspondent)

The week has once more been determined by events in the American copper industry. The sensitivity of the market was underlined on Monday when at one time a drop of £10 had taken place on a rumour that the strike against Anaconda might not take place and on Tuesday, when this proved to be false, the price immediately regained almost all that had been lost. The other three metals have all maintained a very firm undertone and price movements have been in an upward direction.

HOW WILL THE U.S. STRIKES AFFECT COPPER MARKET?

By the time this report is read it is probable that 75 per cent of the U.S. copper mining and smelting industry will be idle, as the Mine Mill Union has given notice that strikes against Anaconda will start on the 19th and against the remainder of Phelps Dodge plants on the 20th. There are many opinions as to the possible effects of such a strike but market people agree that in view of the very high level of fabricators' stocks there will be no shortage of copper for between four to six weeks, and only if then the strike still appears to have some time to run will a buying wave develop. The effect the strike may have on prices later in the year is more difficult to assess, especially as tax considerations may necessitate substantial re-stocking before

the end of the year. Against this, however, it is still the case that with full production an excess of copper is being produced.

World consumption of copper is still running at a high level but is at the moment subject to seasonal influences. This is underlined by the Copper Institute's figures for July which show that production of refined copper in the U.S. fell from the June figure of 138,403 tons to 134,020 tons, whilst deliveries fell from 150,117 tons to 108,127 tons, causing a rise in stocks of refined copper of 17,758 tons, giving a total of 103,432 tons. Outside the United States the picture was even more pronounced with production falling from 146,017 tons to 140,518 tons, July deliveries being only 122,797 tons against 144,115 tons in June and stocks at the end of July rising by 26,367 tons, a total of 286,122 tons.

The London market itself has been very active and, with the exception of the break in price which occurred on Monday afternoon when three months was dealt down to as low as £226 per ton, the undertone has been firm with a tendency for the backwardation to widen. The break on Monday was caused by reports that there was a chance the Mine Mill Union and Anaconda would come to an agreement whereby the company would agree to accept the terms of settlement agreed between the other companies which were struck and the Union, and, in return for this undertaking, the

workers in Montana would not be called out. This news reached various dealers at widely differing times due to Transatlantic communications being disturbed by sunspots and this factor added to the difficulties of the market. On Tuesday morning, however, when it became known that the offer had not been accepted, the price regained most of what was lost and although a certain hesitancy became apparent, the majority of dealers feel that with the actual confirmation that strikes on the 19th and 20th have started, prices will again tend to move in an upward direction. Stocks in official warehouses showed a fall of 245 tons, giving a total last Saturday of 15,038 tons.

STEADY TIN PRICE MAINTAINED

There is nothing to report on the tin market as the Buffer Stock Manager appears to wish to keep the price from rising further for the time being and offerings are on a fairly substantial scale. Consumption, however, remains good and when the U.S. steel strike is settled an upward movement may be seen although by then the export quotas may have been increased. At the moment it is generally considered that on an annual basis the available tin in the world, including metal from the U.S.S.R. and China, is some 20,000 tons less than consumption and that this fact should mean an increase in the export quotas at the next meeting of the International Tin Council.

On the London Market the backwardation has disappeared, although stocks fell a further 172 tons to a total of only 8,553 tons.

On Thursday the Eastern price was equivalent to £815½ c.i.f. per ton Europe.

LONDON METAL AND ORE PRICES, AUG. 20, 1959

METAL PRICES

Aluminium, 99.5%, £180 per ton
Antimony—
English (99%) delivered, 10 cwt. and over £190 per ton
Crude (70%) £190 per ton
Ore (60%) bases 19s. 6d./20s. 6d. nom. per unit, c.i.f.
Arsenic, £400 per ton
Bismuth (min. 1 ton lots) 16s. lb. nom.
Cadmium 9s. 0d. lb.
Cerium (99%) net, £16 0s. lb. delivered U.K.
Chromium, Cr. 99% 6s. 11d./7s. 4d. lb.
Cobalt, 14s. lb.
Germanium, 99.99%, Ge. kilo lots 2s. 5d. per gram
Gold, 250s. 0½d.

Iridium, £23/£25 oz. nom.
Lanthanum (98/99%) 15s. per gram.
Manganese Metal (96% - 98%) £245/£250
Magnesium, 2s. 3d. lb.
Nickel, 99.5% (home trade) £600 per ton
Osmium, £21/£23 oz. nom.
Osmiridium, nom.
Palladium, £6 10s./£7 10s.
Platinum U.K. and Empire Refined £28 10s. oz.
Imported £26½/£27½
Quicksilver, £71½ ex-warehouse
Rhodium, £41/£45 oz.
Ruthenium, £18/£20 oz. nom.
Selenium, 30s. 0d. per lb.
Silver, 79d. f. oz. spot and 78½d. f.d.
Tellurium, 18s. lb.

ORES AND OXIDES

Bismuth 30% 5s. 0d. lb. c.i.f.
20% 3s. 3d. lb. c.i.f.
Chrome Ore—
Rhodesian Metallurgical (semifabrilable) 48% (Ratio 3:1) £15 15s. 0d. per ton c.i.f.
" Hard Lumpy 45% (Ratio 3:1) £15 10s. 0d. per ton c.i.f.
" Refractory 40% £11 0s. 0d. per ton c.i.f.
" Smalls 44% £14 0s. 0d. per ton c.i.f.
" (Ratio 3:1) £11 15s. 0d. per ton f.o.b. nom.
Baluchistan 48% (Ratio 3:1) £11 15s. 0d. per ton f.o.b. nom.
Columbite, 65% combined oxides, high grade £22 13s. 3d. per ton ex. works
Fluorspar—
Acid Grade, Flotated Material £15s. 0d. ex works
Metallurgical (75/80% CaF₂) 40s. 0d./45s. 0d. per unit f.o.b. Beira
Lithium Ore—
Petalite min. 3½% Li₂O 40s. 0d./45s. 0d. per unit f.o.b. Beira
Lepidolite min. 3½% Li₂O £25 0s. per ton f.o.b. Beira
Amblygonite basis 7% Li₂O £28 0s./£30 0s. d/d
Magnesite, ground calcined £21 0s./£23 0s. d/d
Magnesite Raw (ground) nom.
Manganese Ore Indian—
Europe (46% - 48%) basis 57s. 6d. freight nom.
Manganese Ore (43% - 45%) nom.
Manganese Ore (38% - 40%) nom.
Molybdenite (85%) basis 8s. 11d. per lb. (f.o.b.)
Titanium Ore—
Rutile 95/97% TiO₂ (prompt delivery) £29/£30 per ton c.i.f. Aust'n.
Ilmenite 52/54% TiO₂ £11 10s. per ton c.i.f. Malayan
Wolfram and Scheelite (65%) 97s. 0d./101s. 0d. per unit c.i.f.
Vanadium—
Fuse oxide 93% V₂O₅ 8s./8s. 11d. per lb. V₂O₅ c.i.f.
Zircon Sand (Australian) 65 66% ZrO₂ £16/£17 ton c.i.f.

STRONG LEAD-ZINC MARKETS

The steadiness of the lead market has been a feature of the past weeks and an appreciable price rise has now taken place in the expectation that demand in the autumn will prove to be better than last year. Sentimentally, the London market may be helped by a rise in the U.S. quotation but practically it should have no difference as full use has been made of the import quotas since they were introduced.

The demand for zinc continues and, here again, the steadiness in the U.S. quotation, in spite of the steel strike, is of sentimental value but, again, the quota system really isolates the two markets.

Closing prices are as follows:

	Aug. 13		Aug. 20	
	Buyers	Sellers	Buyers	Sellers
COPPER				
Cash	£236½	£236½	£234	£235
Three months ..	£235½	£235½	£233	£233½
Settlement ..	£236½		£235	
Week's turnover ..	14,625 tons		11,600 tons	
LEAD				
Current ½ month ..	£72½	£72½	£73	£73½
Three months ..	£73½	£73½	£74	£74½
Week's turnover ..	11,300 tons		10,550 tons	
TIN				
Cash	£792½	£793	£792½	£793
Three months ..	£791	£792	£792½	£793
Settlement ..	£793		£793	
Week's turnover ..	550 tons		645 tons	
ZINC				
Current ½ month ..	£85½	£86	£86½	£86½
Three months ..	£84½	£84½	£85	£85½
Week's turnover ..	6,275 tons		5,050 tons	

Mining Finance

West Drie Hits the Jackpot

West Driefontein, the Far Western Rand gold and uranium producer in the Consolidated Gold Fields group, has struck the Carbon Leader at depth in the central western part of its large property with gold values that are far above the average for the mine to date.

The intersection occurred in the No. 5A sub-vertical shaft at a depth of 993 ft. below the collar on the 18th level, or 6,320 ft. below the surface. The reef was present all round the periphery of the shaft and 16 sections were sampled giving an average gold value of 290.8 dwt. per ton, which is just on 14½ oz., over a reef channel width of 9.1 in., equal to 2,646 in. dwt. The uranium content was also well above average at 3.32 lb. per ton over the same width, equal to 30.2 in. lb. Over the past year or two development of the Carbon Leader in the upper levels of this part of the mine has been giving between 600 and 800 in. dwt.

The only parallel to the latest strike is that from the UD9 borehole in the Western Deep property to the south. A year or two back this gave the very high value of 4,338 in. dwt. from a depth of 9,020 ft. phenomenal because the Carbon Leader being a soft reef tends to be ground away by the drill in boreholes and thus very often yields an imperfect sample when the core is drawn up. The UD9 hole lies rather more than 1½ miles to the south-east of West Driefontein's

No. 5 shaft. Roughly midway between the borehole and the shaft lies borehole UD4 which is near the common boundary of the two properties and which gave 493 in. dwt. at 7,401 ft. from an imperfect intersection of the Carbon Leader.

There is no doubt that the latest West Driefontein strike, stemming as it does from the much more solid evidence of sampling all round the rim of a large-sized shaft, gives the life of this mine in the western half of the big property not only a new degree of certainty, but indicates that the falling away in grade during the past year or so may be no more than temporary. The average gold content of the ore reserves at June 30 was 15.7 dwt. a ton, while in the June quarter the high degree of sorting was enabling the gold recovery per ton milled to be as high as 18.3 dwt. Now there is a chance that West Driefontein may eventually be able to obtain an ounce or more per ton, anyway from the western half of the property. In the more distant future, of course, the inclusion of tonnages from the Main and Ventersdorp Contact reefs is likely to bring down the average richness, but there is little need to worry about this yet awhile.

West Driefontein's earnings are running at about 14s. a share per annum after tax which currently takes over 40

per cent of the gross profit from gold and uranium. The June half-yearly dividend was 4s. 3d. giving a yield of 5.2 per cent at the price of £8½ to which the 10s. shares have soared as a result of the news. Dividends should, of course, expand further over the next year or two.

POINTER FOR WESTERN DEEP

The £1 "A" shares of Western Deep Levels have naturally also been stimulated by the West Driefontein strike because the No. 5 shaft system is less than half a mile from the common boundary. Western Deep is shaft-sinking at an exceedingly rapid rate in order to open up both the Carbon Leader and Ventersdorp Contact reefs at depth immediately to the south of West Driefontein. If the Carbon Leader proves to be anywhere near as rich as indicated in the No. 5 shaft strike, there will be a much greater chance of Western Deep overcoming the cost problem that will be inevitable for a mine that will start working this reef at depths ranging from 1½ miles to well over 2 miles below the surface. The first actual evidence from development work in the Western Deep mine is coming from the less rich Ventersdorp Contact reef, on which some limited sampling is now being done in a drive extended from a winze put down from West Driefontein's 16th level. In the June quarter a few pay feet averaged 354 in. dwt. There should be more results from this drive in the current quarter.

Other shares to respond to the West Drie news have been West Wits and West Rand Investment. The latter company held just over 1,000,000 West Driefontein at the end of 1958 and in addition had a similar number of West Wits.

LONDON MARKET HIGHLIGHTS

The first half of the week in the South African Gold share market was given over to the Far West Rand group. This resulted from West Driefontein's rich strike on the Carbon Leader reef at depth in the No. 5A sub-vertical shaft. Even for this rich producer the values were high, auguring well for the neighbouring Western Deep Levels property.

West Driefontein advanced 5s. to 167s. 6d. and continued Cape bidding raised Western Deep to 47s. In sympathy, West Wits moved up to 74s. 6d. and in view of their big holding in West Driefontein, "Writs" were marked up to 63s. The Natal disturbances and the South African political upset had surprisingly little effect on the market.

Wednesday saw interest swing back to the O.F.S. issues which moved ahead under the lead of Free State Geduld. Buying of F.S.G. (5s. up at 191s. 3d.) was triggered by Cape talk of an imminent announcement giving gold values in the deflection of the 1,040 in.-dwt. borehole recently put down in the No. 1A ventilation shaft area. Blinkpoort jumped to 97s. 6d. and Western Holdings to 173s. 9d. Loraine (38s.) had its own little boomlet that arose following persistent Cape rumours of high development values. Finance issues maintained their firmness, Anglo American advancing to 197s. 6d.

Copper shares were unaffected by the fluctuations in the metal price and were

little changed on balance in quiet trading. Tins came to life following the optimistic forecast in the Consolidated Tin Smelters' report. Among many gains, Ayer Hitam improved to 38s. 6d. Beralit (30s.) responded to a revival in the demand for wolfram which has lifted the price by 2s. to 99s. a unit in the past few days.

Lead-zincs also staged a comeback. A more promising outlook for the twin metals made buyers ignore the humble yields presently offered and share prices moved ahead. Rhodesia Broken Hill which, exceptionally, yield as much as 7.6 per cent moved up to 9s. 9d., while Mount Isa (47s.) which give barely 1 per cent also rose on what appeared to be an insatiable Australian demand.

There were several noteworthy features in the miscellaneous group. Outstanding among them was the persistent speculative buying which lifted Mountain Copper to 17s. 9d.; as usual in these cases, rather vague take-over talk accompanied the move. Yukon Consolidated—there was still no fresh developments in the bid situation—improved to 6s. 6d. after news of big oil and gas finds in the Yukon. There was also news of a change for the better in the fortunes of Esperanza Copper and Sulphur; ore shipments have risen sharply while debenture arrears and temporary loans have been settled; the shares accordingly improved to 1s. 10½.

MR. WAITE ON TIN OUTLOOK

Mr. Clifford Waite, chairman of Consolidated Tin Smelters the world-wide smelting company, can always be relied upon for some interesting views on the outlook for tin and his latest statement accompanying the annual report for the year to last March is no exception. It confirms the share market's impression that tins may come back into favour during the latter part of this year. Apart from the inevitable caveat concerning the possible adverse effects of the U.S. steel strike should it become unduly prolonged, Mr. Waite thinks that output quotas under the International Tin Agreement should be further increased in the fourth quarter of 1959. He backs up this view with estimates that there may be a world shortfall of around 21,000 tons of metal this year if there were to be no quota increase in the last quarter. (See page 172.)

AMERICAN METAL'S RECOVERY

American Metal Climax, the American base-metal concern which forms one of the Selection Trust's major investment holdings, has stepped up its net earnings for the first half of this year by close on 90 per cent compared with 1958. The surplus of \$14,567,000 contrasts with \$7,699,000 in the first six months of last year. On a per share basis the comparison is between \$1.02 and 53 cents. Higher metal prices will naturally have been the major factor. There is also a special non-recurring slice of revenue amounting to 18 cents a share resulting from the taxed profit that arose through the

MINING FINANCE—Continued

company's disposal of its interests in British Aluminium and Consolidated Coppermines Corporation.

The customary 30 cents a share quarterly dividend has been declared. Of most interest to Selection Trust shareholders is whether or not American Metal's profits recovery will lead to an increase in the \$1.20 dividend paid for each of the last two years. Although it is an American company, A.M.C. should, if anything, benefit from the growing labour troubles in the U.S. copper-producing industry. Its major copper stake lies through its controlling interest in Rhodesian Selection Trust and its 33 per cent holding in Roan Antelope. These companies are already in line for higher dividends in the year that ended on June 30. If

the metal price is boosted by any really prolonged stoppage of production in the U.S. then these Rhodesian concerns should make a good start to their current financial years. And, incidentally, their recently announced 10 per cent output cut for the good of the cause may not in this event prove necessary.

The chief snag in the American Metal outlook is the adverse effect that that other U.S. labour stoppage, in the steel industry, may have on the demand for molybdenum, a metal that has loomed largely in the company's fortunes since the amalgamation with Clymax Molybdenum at the end of 1957. If this particular strike is not unduly prolonged then Selection Trust stands a good chance of getting a higher return from this important holding in its financial year that ends on March 31 next.

CONSOLIDATED TIN SMELTERS LTD.

The thirtieth annual general meeting of Consolidated Tin Smelters, Ltd., will be held on September 10 in London.

The following is an extract from the circulated statement of the Chairman and Managing Director, **Mr. Clifford Waite** :—

Last year I warned shareholders that while tin exports were subject to control the Group's profits would be curtailed. The trading profits have, in fact, fallen from £1,191,965 to £855,885 in the year to March 31, 1959, and the net profit, after tax, from £531,219 to £396,301. Your Directors are glad to be able to recommend a dividend of 3s. and a bonus of 6d. per £1 unit of Ordinary Stock, a total of 3s. 6d. per unit, as last year.

International Tin Agreement

When deciding the level of exports for the fourth quarter, the Council will have to take into account the proportions of cash and metal which it is desired to hold in the Buffer Stock. I consider that a slightly greater proportion should be held in cash, say 12,000 tons in cash and 11,000 tons in metal. By the end of June perhaps 8,000 tons may have been converted into cash, but as exports increase and with the addition of sales from the U.K. stockpile, the rate of disposal by the Buffer Stock Manager during the next three months will decline. However, export quotas can, if necessary, be increased at short notice and the additional production of some countries marketed within a few weeks.

The Outlook for 1959

After the storms of 1958 it does seem that the International Tin Agreement is now sailing in calmer waters, and the outlook is considerably more promising than it was twelve months ago. In the first place the U.S.A. economy has emerged from its recession and recent demand from that country has been buoyant. The same is generally true of the major tin consumers in Europe. Secondly, the effects of restriction of tin exports have really made themselves felt in the first half of 1959, and thirdly a known ceiling has been placed on U.S.S.R. exports.

Figures for world consumption during the first quarter of 1959 indicate a significant increase over the same period of 1958, and it seems probable that for the whole of 1959 consumption will recover approximately to the level of 1957. Assuming for the moment that permissible exports for the fourth quarter are fixed at the same figure as for the third quarter—25,000 tons—then I estimate that consumption during 1959 should exceed available supplies by some 21,000.

It seems certain that some control of tin exports will continue throughout our financial year to March 31, 1960. Although the permitted level of exports is likely to rise during the second half of the year, I can only anticipate a small increase in the tonnage of tin concentrates to be treated at our smelting works at Bootle and Penang, after taking into account the additional tonnage of barter concentrates due to be received from Bolivia. In these circumstances, the Group's trading profits may be about the same as for the year under review, but we cannot expect to receive the same substantial tax credit so that the amount available for distribution may be somewhat less.

DAVIES INVESTMENTS LTD.,

Bankers, still offer 7½ per cent on sums £20 to £500 (withdrawal on demand) with extra ½ per cent on each £500 unit. Details from Investment Dept. MN, Davies Investments Ltd., Danes Inn House, 265 Strand, London, W.C.2.

FOR SALE. Off-Shore. Drilling Tower, either as a working unit or for demolition as it stands in Granton Harbour, near Edinburgh. Offers will also be considered for individual items of equipment installed on the tower.

The tower is capable of working in 80 ft. of water and has been used for proving coal seams under the Firth-of-Forth. It is normally repositioned by towing on pontoons. The tower comprises a bolted tubular steel frame and braced structure supported on a cruciform base formed by two diagonally placed steel box girders and surmounted by one accommodation and one working deck. The total weight is approximately 390 tons which includes 128 tons of tubular steelwork and 165 tons of steel plate and sections. The tower is completely self-sufficient so far as equipment, power, galley, storage and living accommodation are concerned. The main power units comprise three Crompton Parkinson D.C. generators each rated at 50 kW at 440/220v driven by Crossley diesel engines rated at 100 b.h.p. at 500 r.p.m.

The rig used in drilling operations has been removed. Pontoons used in lifting and moving the tower are in current use for similar operations in the North Sea, and the Board will be prepared to consider granting the use of these pontoons on agreed terms to move the tower intact for a limited distance from its present location.

Tender forms, conditions of sale and permission to inspect may be obtained on application to the Chief Contracts Officer, National Coal Board, Hobart House, Grosvenor Place, London, S.W.1.

Closing date for receipt of tenders will be 12 noon on October 15, 1959.

GHANA : UNDERGROUND MANAGER.

Applications are invited from qualified Mining Engineers for the above position, which is one of individual responsibility with excellent prospects. Previous metalliferous mining experience in a senior capacity is essential. Age at least 30. Salary not less than £2,160. Leave on full pay at the rate of 3 months after 12 months service, with free passages. Marriage allowance of £180 per annum or free passages for Wife each tour; non-contributory pension scheme; car provided for use on the Mine. Accommodation, medical attention and certain other services provided free. Good social and sports facilities. Income Tax at low local rates.

Details of training and career to date, in confidence to Box No. 640, **The Mining Journal Ltd., 15 Wilson Street, Moorgate, London, E.C.2.**

FEDERATION OF NIGERIA : PETROLEUM ENGINEER, MINES DEPARTMENT.

Qualifications : A degree or equivalent qualification in geology or in oil, mining or mechanical engineering followed by specialization in oil technology with at least 10 years' experience in oil exploration and development of oil fields. Post-graduate or specialist training in petroleum reservoir engineering and knowledge of fiscalisation of oil desirable.

Duties : To build up a hydrocarbon section of the Mines Department responsible for supervising oil exploration and exploitation activities, measuring oil produced and saved and assessing royalty, preparing reports, statistics, etc., ensuring the proper application of relevant legislation and regulations and preparing training schemes in oil technology.

Terms of Appointment : On contract for one tour of 12-18 months in the first instance, with gratuity on satisfactory completion of contract. Salary not exceeding £4,000 p.a. Free passages for officer and wife. Passage concessions and allowances for children. Quarters provided at rental if available. House or hotel allowance if quarters not provided. Generous leave. Taxation at local rates.

Apply to Director of Recruitment, Colonial Office, London, S.W.1. State age, qualifications and experience. Quote BCD 99/14/012.

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